Data Use in U.S. Caribbean Stock Assessments

NOAA FISHERIES

Southeast Fisheries Science Center

SEFSC PROGRAM REVIEW

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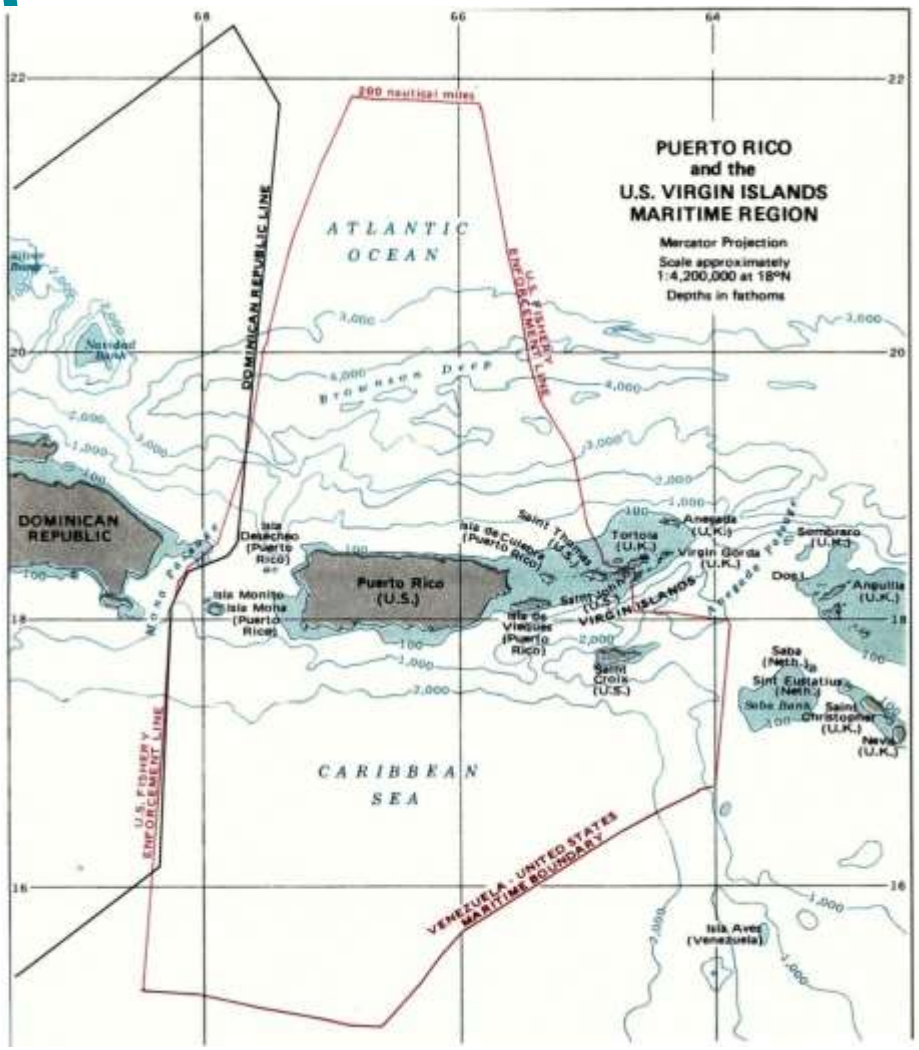
Slides summarizing available data and stock assessment models used to produce management advice in the U.S. Caribbean

Caribbean Region

- Puerto Rico
- St. Thomas
- St. John
- St. Croix



Fisheries Management

- Managed by CFMC using species complexes and ACLs computed from recent landings

ACL values for overfishing species within the US Caribbean EEZ Region

Table 1. Puerto Rico EEZ

Fishery Managed Unit	Maximum Annual Commercial Catch (lbs)	Maximum Annual Recreational Catch (lbs)
Snapper Unit 1	284,685	95,526
Snapper Unit 2	145,916	34,810
Snapper Unit 3	345,775	83,158
Snapper Unit 4	373,295	28,509
Groupers*	177,513	77,213
Parrotfish**	52,737	15,263
Queen Conch	0	0

Table 2. St. Croix and St. Thomas/St. John EEZ

Fishery Managed Unit	St. Croix Maximum Annual Commercial and Recreational Catch (lbs)	St. Thomas/St. John Maximum Annual Commercial and Recreational Catch (lbs)
Snappers	102,946	133,775
Groupers*	30,435	51,849
Parrotfish**	240,000	42,500
Queen Conch	50,000	0

Table 1 and Table 2:
* Except NO fishing for Nassau and Goliath groupers.
** Except NO fishing for midnight, blue and rainbow parrotfish

F.S. 2, April 2013

Fishery Independent Information

- St. Croix Trap Survey:
  - Cost-effective spatially comprehensive sample design.
  - Novel sampling design includes random stratified by bottom, systematic (model based) and fixed station components.
  - Conducted during 2010 only. Provided size composition, catch rates, strategy for statistically rigorous sampling design.

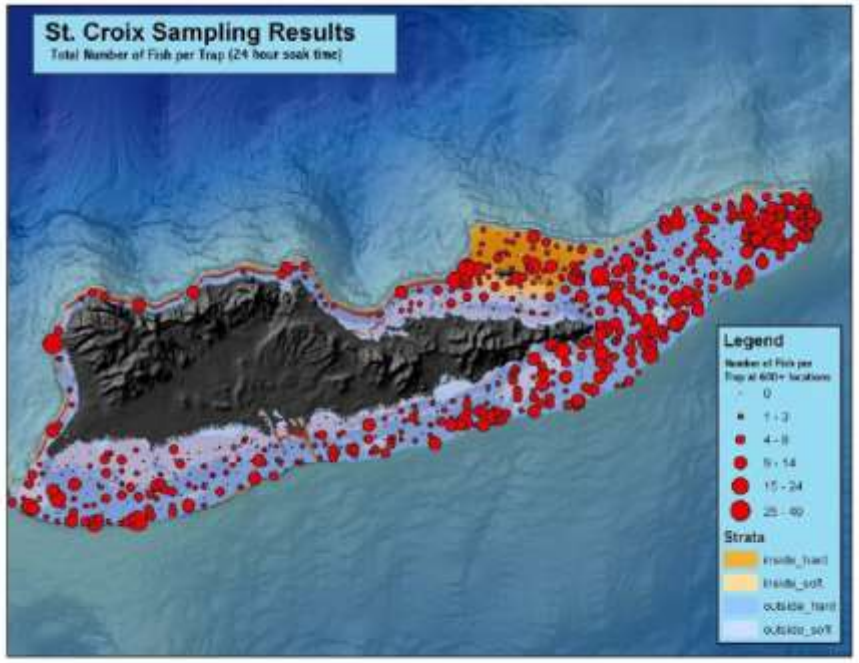
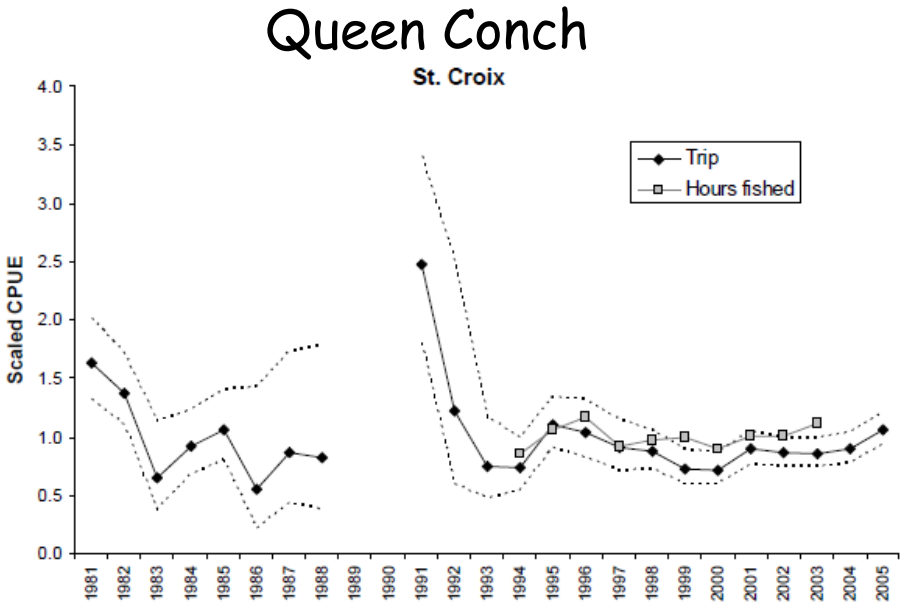


Figure 3. Map indicating the number of fish caught per trap in survey locations around St. Croix.

Fishery Independent Information

- NOS visual survey and REEF (Reef Education and Environmental Foundation) diver surveys are useful for some assessment (e.g. conch, mutton snapper).
  - Limited to depths that divers can reach
  - Historically spatially limited



Fishery Independent Information

- Historical FI information described in SEDAR 26 DW 6
  - 04-097 06/13 - 08/03/1979 Reef Fish Habitat/Miami Swordfish
  - 04-108 06/17 - 07/24/1980 Caribbean Reef Fish
  - 04-119 07/13 - 07/28/1981 Caribbean Reef Fish
  - 04-129 09/01 - 09/30/1982 Deep Water Snapper-Grouper
  - 21-836 05/25 - 07/20/1983 Deepwater Snapper/Grouper
  - 21-844 04/10 - 05/14/1984 Deepwater Snapper
  - 28-857 10/01 - 10/23/1985 Caribbean Reef Fish
  - 04-285 03/05 - 04/08/2009 Caribbean Reef Fish

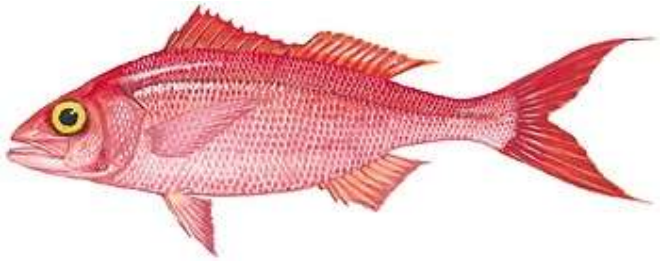
Addendum Table 1. Number of stations completed off Puerto Rico and the U.S. Virgin Islands (USVI) with various gear types during fisheries independent surveys conducted between 1979 and 1985.

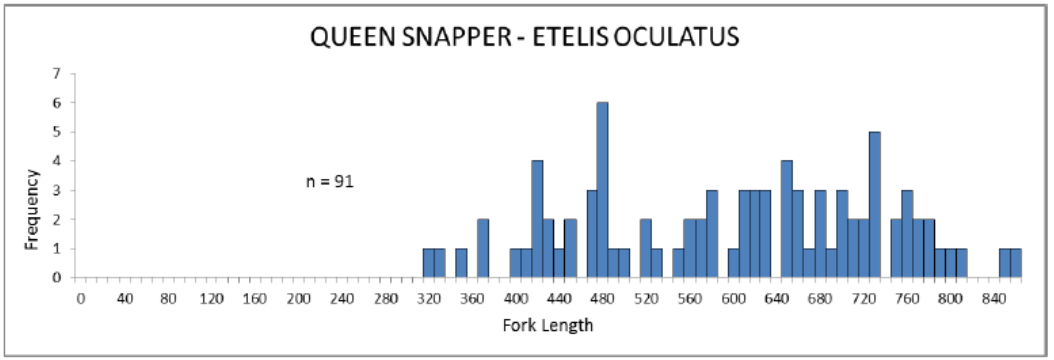
	Bottom Longline		Off Bottom Longline		Handline		Trap	
Year	Puerto Rico	U.S.V.I.	Puerto Rico	U.S.V.I.	Puerto Rico	U.S.V.I.	Puerto Rico	U.S.V.I.
1979	48	11			26	3	3	1
1980	96	9			18	5	10	2
1981	13				1		1	
1982	98	13	98	13	4		16	2
1983	130	10	128	10			12	
1984	83	5	85	5		1	1	
1985	34	15	33	15			40	20

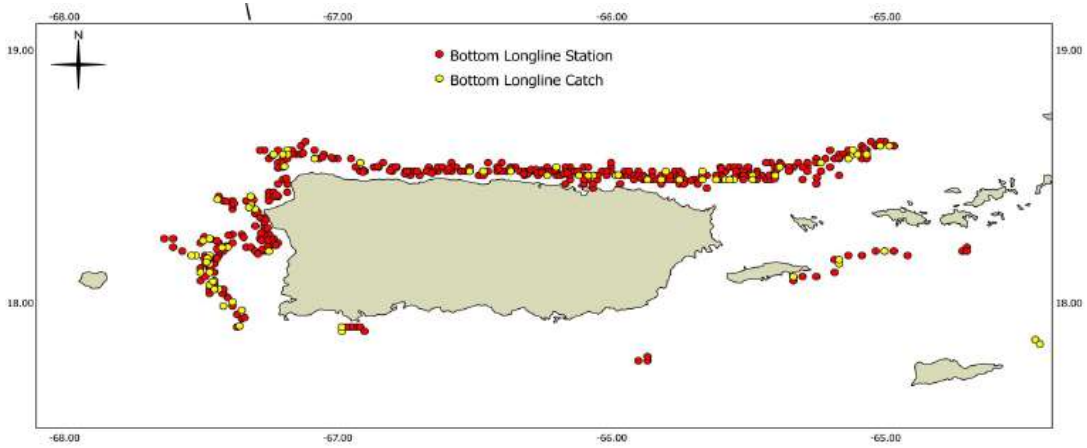
Fishery Independent Information

- Historical FI information:
  - Contains information about spatial distribution, length frequency, CPUE

e.g. Queen Snapper







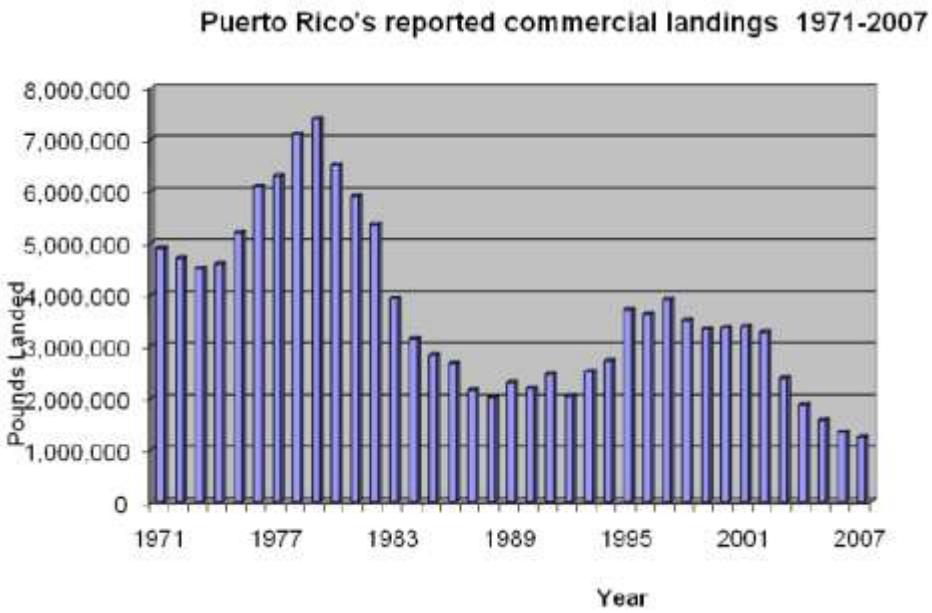
Survey Year	Frequency	*N*	DL Index
1979	0.16667	48	0.07675
1980	0.17708	95	0.17112
1981	0.30769	13	0.40738
1982	0.14286	98	0.16534
1983	0.06923	130	0.11723
1984	0.12048	77	0.17655
1985	0.05882	33	0.06136

Typical Data for Stock Assessment

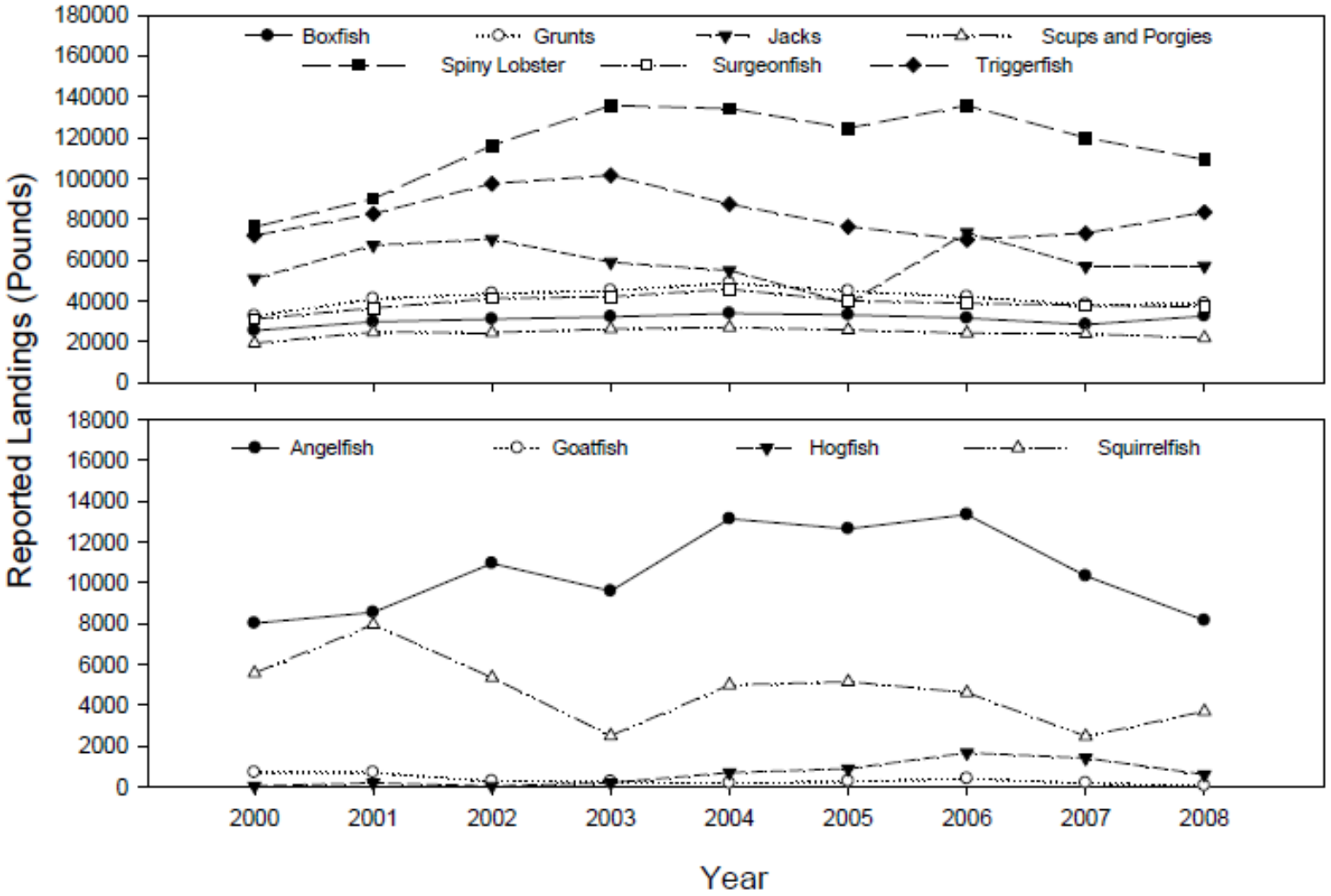
- Fishery Dependent Statistics
  - Landings
    - Recreational
    - Commercial
  - Size composition
  - Life history relationships
    - Growth
    - Length - weight
  - CPUE (standardized, indices of abundance)
- **CHALLENGE: The input data and total landings are relatively uncertain.**

Commercial Landings

- Reports available beginning in 1967 in Puerto Rico (1983 in electronic format); 1974 in St. Thomas/St. John; 1975 in St. Croix.
- U.S. VI:
  - Conch and Lobster: Throughout time series.
  - Snapper and Grouper records from 1974 to present
  - Family group reported in 1998.
  - Species specific records begin in July 2011.

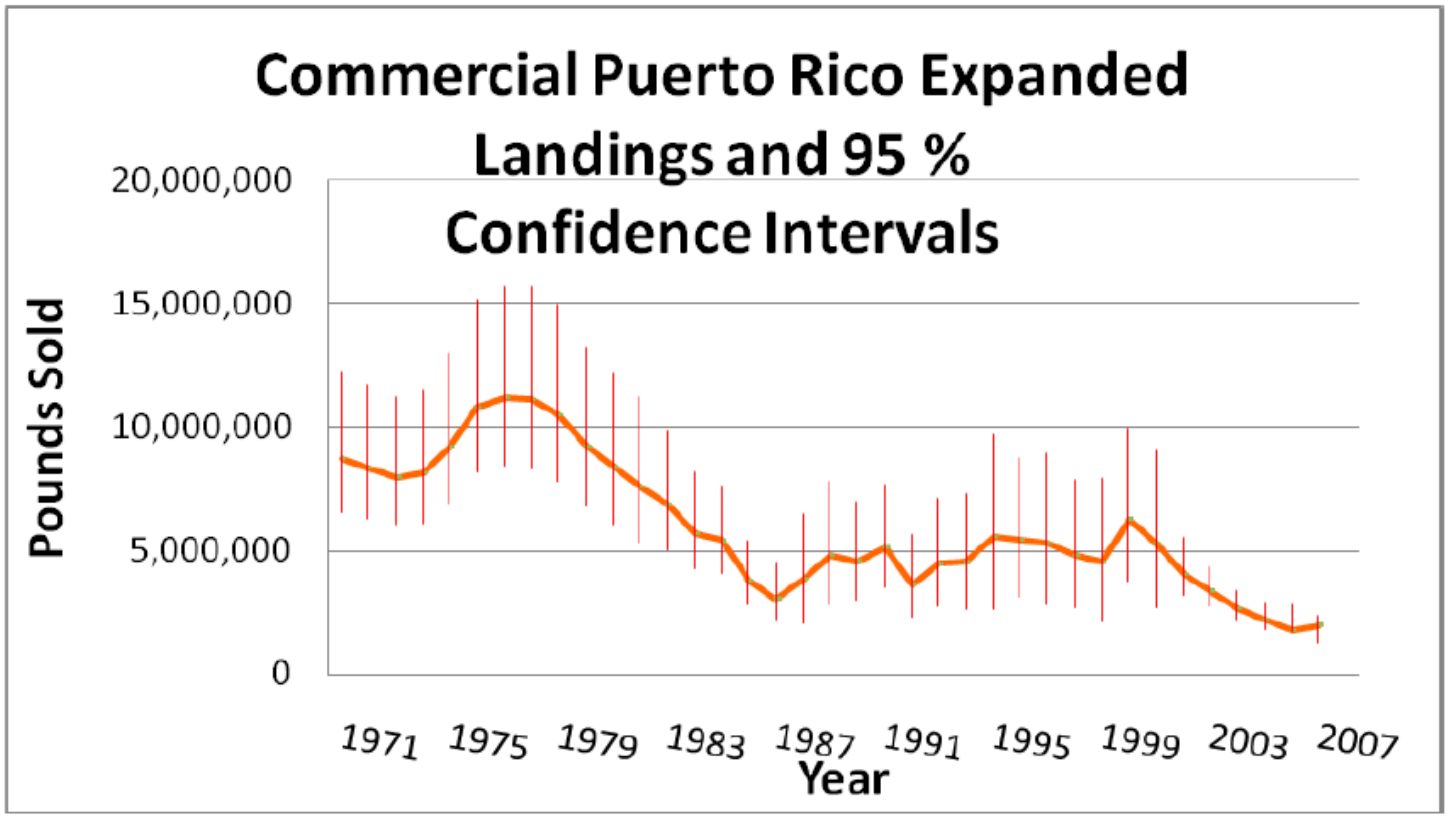


Commercial Landings



Commercial Landings

- Expansions factors are used with in Puerto Rico to calculate total landings from partial landings statistics.



Recreational Landings

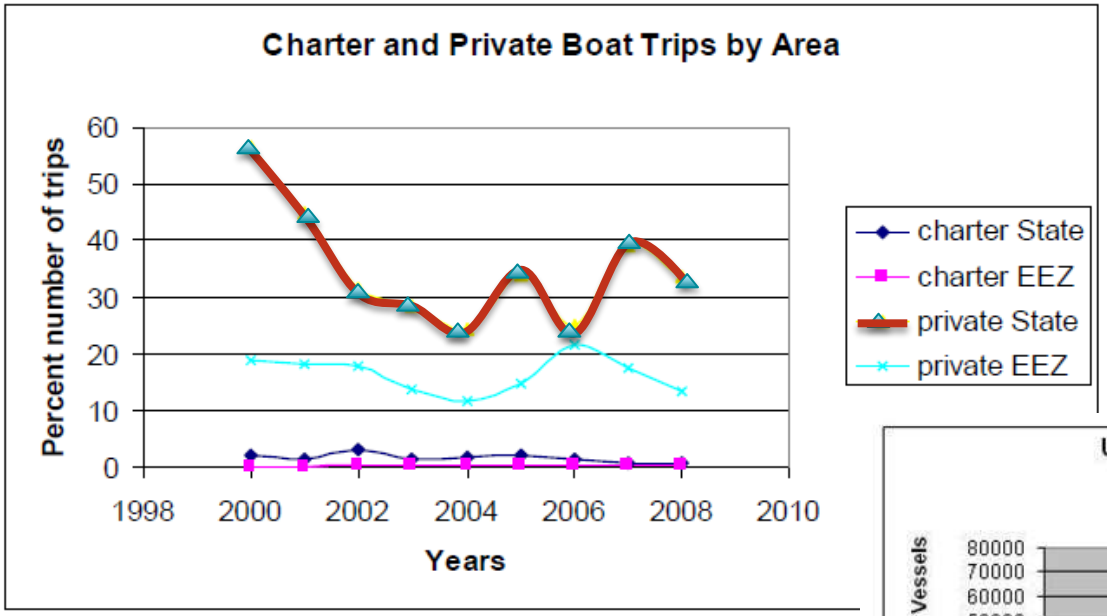
- Data available from Puerto Rico since 2000 under the Marine Recreational Fisheries Statistic Survey (MRFSS), but ***complementary data are not available for the USVI.***
- MRFSS collects catch information on finfish, but generally does not include invertebrates such as conch and lobster.

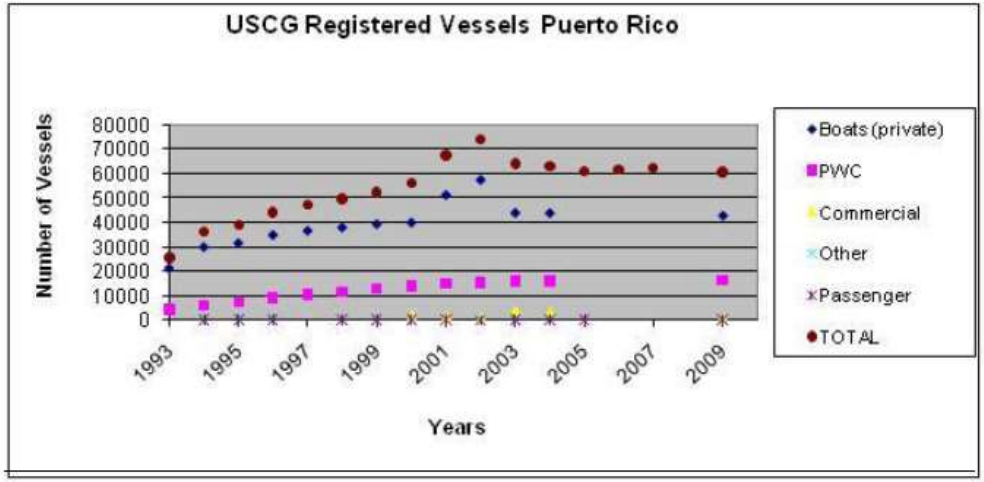
Table 3.2.4. (Continued). Puerto Rico recreational landings during 2000-2009. Also included are averages and medians for 2000-2005 (the longest time period prior to implementation of the Comprehensive Sustainable Fisheries Act Amendment), 2000-2009 (for the entire sequence of years), and 2005-2009 (the most recent five years presently available). Numbers are in pounds of whole animals (numbers of fish reported are in parentheses). The text box lists the individual species included within each of the FMU categories. Source-SEFSC 2011 ACL data sets (March 17, 2011).

Year	Aquarium Fish	Angelfish	Boxfish	Goatfish	Grunts	Wrasses	Jacks	Scups and Porgies	Tilefish	Squirrelfish	Surgeonfish	Triggerfish and Filefish
Avg. 00-09	7,819 (6,430)	881 (327)	8,005 (4,873)	543 (1,221)	7,276 (16,687)	6,233 (5,694)	88,660 (65,963)	3,349 (4,002)	1,219 (1,964)	5,244 (11,469)	617 (922)	37,357 (19,795)
Avg. 05-09	2,388 (2,602)	53 (43)	3,361 (2,064)	230 (416)	4,331 (9,465)	5,370 (2,593)	42,426 (29,048)	1,978 (1,806)	115 (261)	4,730 (9,203)	57 (69)	23,296 (10,660)
Median 00-05	10,490	0	7,381	507	6,487	5,611	107,232	3,576	1,360	4,607	61	51,354
Median 00-09	5,920 (6,093)	0	5,129 (2,733)	402 (864)	5,587 (13,149)	5,611 (5,421)	56,668 (63,764)	2,863 (2,327)	NA	4,323 (10,103)	NA	24,365 (14,239)
Median 05-09	1,359	0	2,718	0	4,353	2,792	48,899	2,809	0	1,386	0	17,837

Effort Estimates

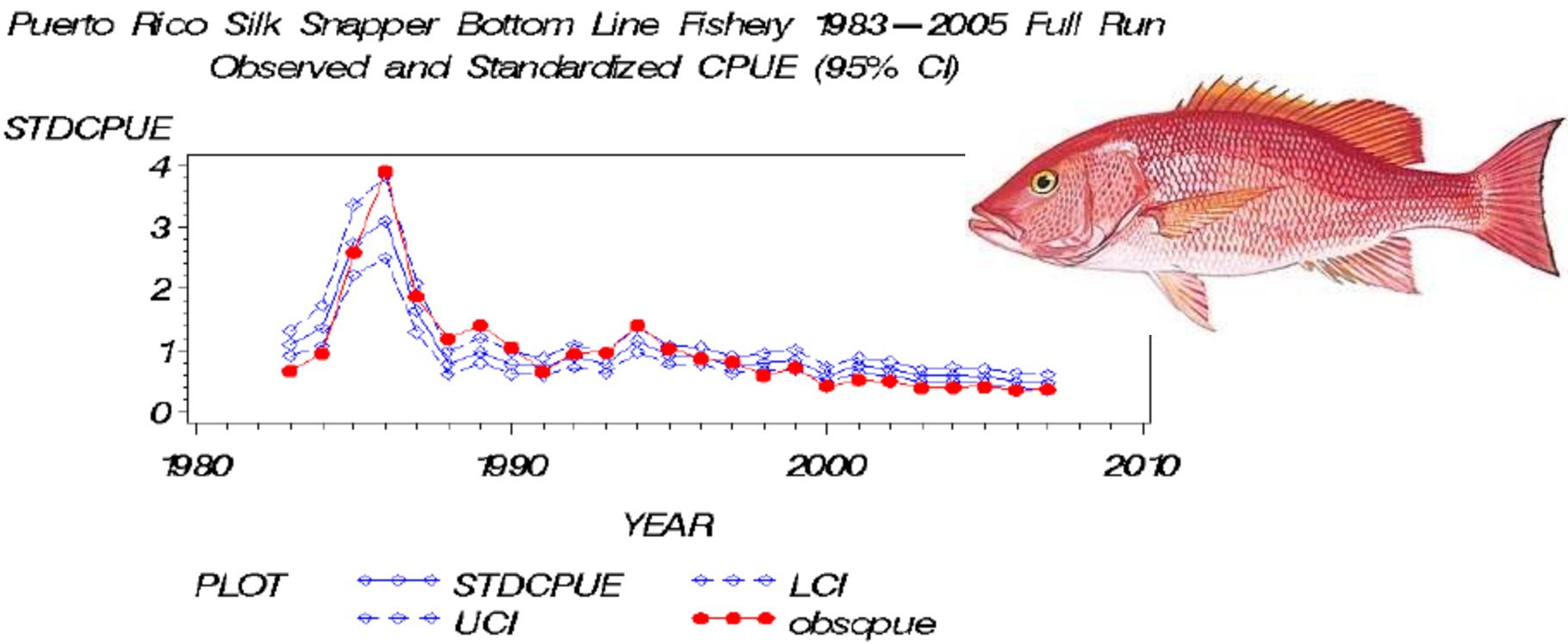
- MRFSS, and registered vessels (US Coast Guard)





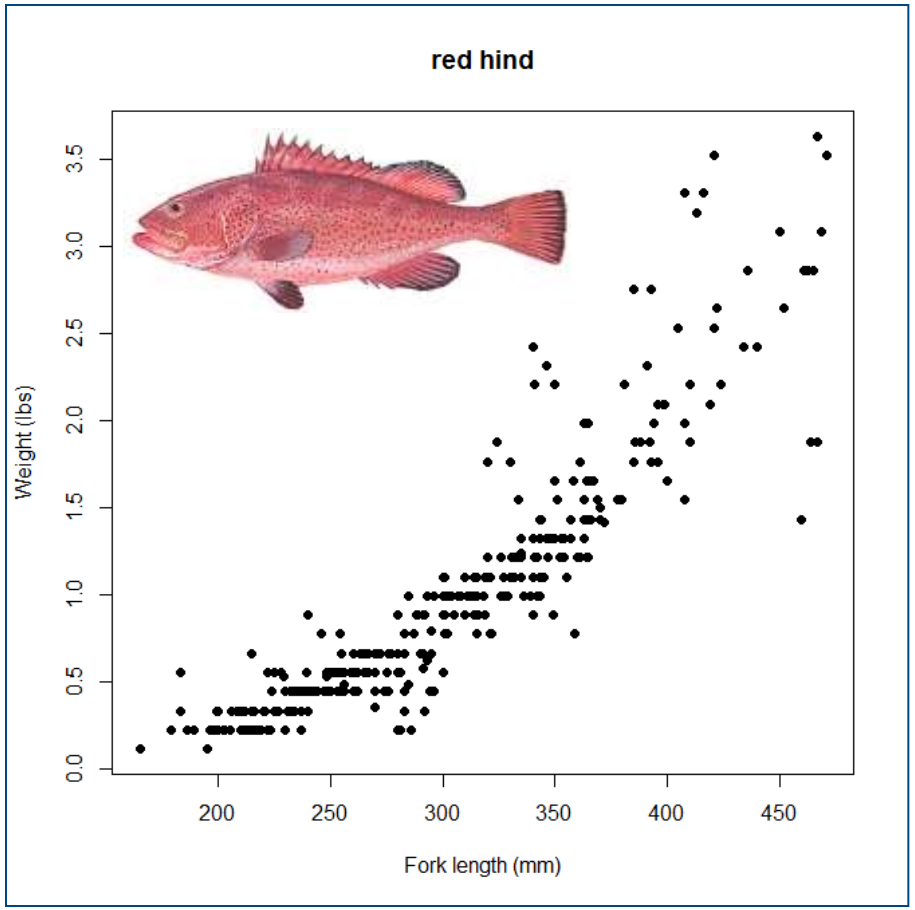
Catch per Unit Effort

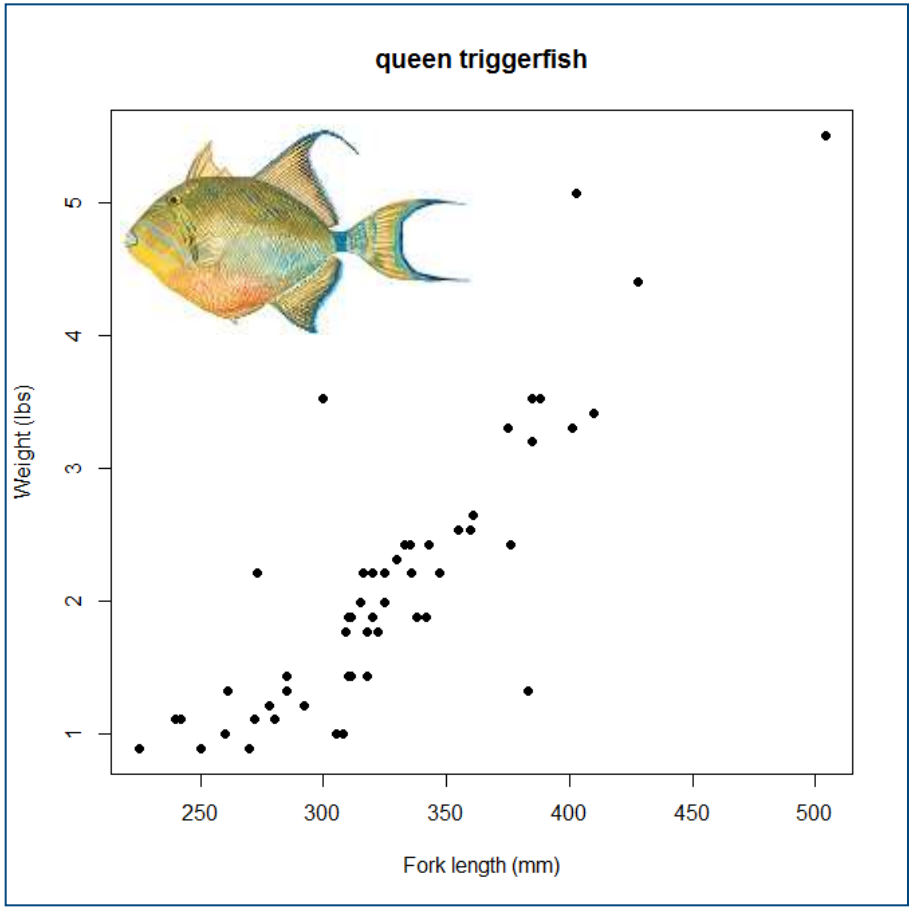
- FI and FD CPUE series have been constructed for some species and gears. May be useful for some species. Sample sizes are often inadequate.



Length – Weight

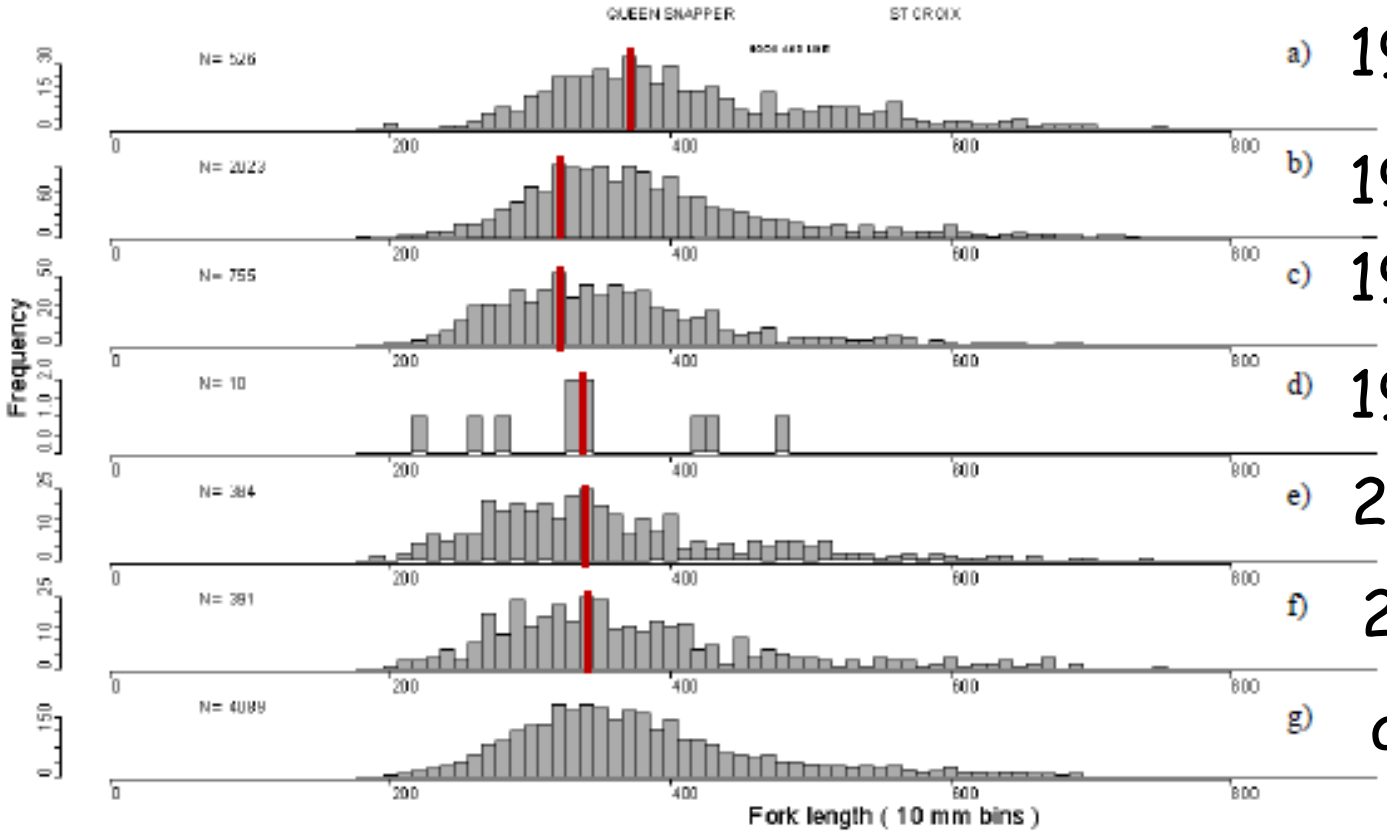
- MRFSS, additional studies conducted by academic and regional partners





Length Frequency

- The most temporally consistent data available in the US Caribbean for assessment purposes is the length frequency data provided by the SEFSC Trip Interview Program (TIP).



Stock Assessment Methods

- ***Mean-Length Estimator*** (Gedamke and Hoenig, 2006). Minimal data requirements as compared to traditional stock assessment methods
- ***Requires:***
  - A time series of length frequency
  - von Bertalanffy growth parameters
- ***Assumptions:***
  - Asymptotic growth, where the asymptotic length and von Bertalanffy growth coefficient are known and constant over time.
  - No individual variability in growth
  - Constant and continuous growth over time
  - Constancy of fishery: no changes in gear, selectivity, area etc.

Stock Assessment Models

- Model estimates
  - Length at Full Selection (*Lc*)
  - Mean Length above *Lc*
  - Total Mortality (*Z = F+M*)
- Given an estimated natural mortality (M), can estimate F

$$M = \begin{cases} e^{-0.0152+0.6543\ln(k)-0.279\ln(L_\infty+0.4634\ln(Temp))}, & Pauly\ 1980 \\ 0.0189 + 2.06k, & Ralston\ 1987 \\ 1.5k, & Jensen\ 1996 \end{cases}$$

- Equilibrium vulnerable biomass per recruit can be obtained using an incidence function (Botsford 1981, Walters and Martell 2004).
- Yield per recruit (YPR) and Spawning biomass per recruit can also be estimated .

Stock Assessment Models

- Yield per recruit curves can be constructed for each realization of the input parameters

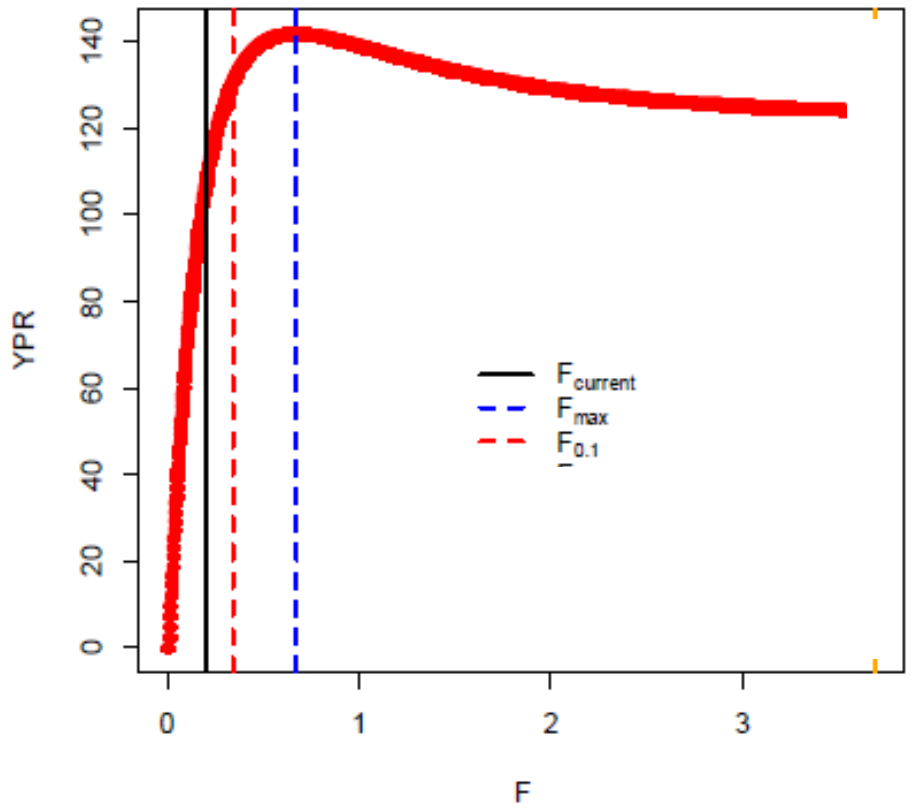


Figure 2. An example yield per recruit curve. Fishing mortality is on the x-axis and yield per recruit is on the y-axis. To derive this YPR curve the following values were used: $t_c = 2$, $k = 0.25$, $L_\infty = 86.6$cm, and $M = 0.426$ and was derived from Pauly (1980). The black line represents the estimate of current fishing mortality ($F_{current}$) from the mean-length estimator.

Stock Assessment Models

- Given the choice of Fmsy proxy, probability of overfishing can be estimated
- Given reliable recent landings and a control rule that applies a scalar, ACL could be estimated

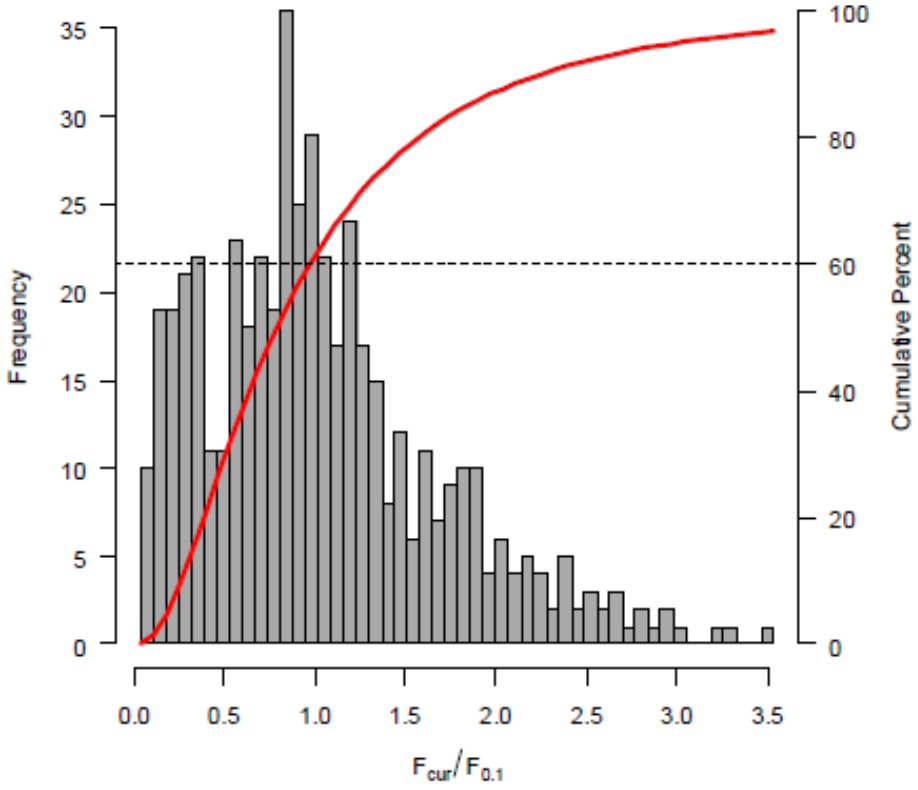


Figure 3. The frequency of occurrence and the cumulative probability of the ratio between $F_{current}$ and $F_{0.1}$ for queen snapper captured by the hook and line fishery in Puerto Rico. A ratio greater than 1 indicates the fishery is experiencing overfishing, a value less than one indicates the fishery is not experiencing overfishing. The dashed line indicates that the probability of F-ratio ≤ 1 is 60% given the assumed uncertainty in the life history parameters and natural mortality.

Summary

- Lack of representative age, growth and maturity biological samples hampers stock assessments. FishBase often source of most reliable information.
- FI surveys spatially and/or temporally limited – restricted depth range.
- Some quantitative assessments are possible with extant data (i.e. conch, lobster) but time series often lack contrast needed to characterize stock status.

Summary

- By definition, only reliable catch series (ORCS) approaches require reliable catch series. Additional resources are critically needed to validate catch in the Caribbean.
- Mean-Length estimator can be used to estimate ACLs for data-poor stocks, but requires representative length and age samples and reliable catch information. Additional resources to obtain representative biological samples would improve management advice.